

4-15-14

**US EPA
Source Test Report**

**XTO Energy, Inc.
RBU 11-18F Facility,
Utah**

March 18, 2014

Permit: EPA Consent Decree

Engine: Caterpillar G3516LE

SN: WPW00173

Unit ID: #3

Prepared By:

Oasis Emission Consultants, Inc.
2730 Commercial Way
Rock Springs, WY 82901





April 15, 2014

Ms. Rykki Tepe
XTO Energy, Inc.
810 Houston Street
Fort Worth, TX 76102

Dear Ms. Tepe:

**Re: Engine Emission Testing For XTO Energy, Inc., RBU 11-18F Facility
Unit #3.**

Oasis Emission Consultants, Inc. was requested to perform an engine emission test on a Caterpillar G3516LE lean burn engine located on tribal land in Utah.

Emission Levels

The average recorded levels were found to comply with emission levels stipulated in the guidelines of the EPA Consent Decree, as shown in the attached report, and summarized below.

Emission Unit	Avg NOx	Avg CO
g/BHP-hr	1.09	0.01
lbs/hr	3.01	0.02

Formaldehyde Levels

Test Run	HCOH (ppm)	HCOH @ 15% O2 (ppm)	HCOH @ 15 % O2 Limit
1	1.39	0.65	14
2	1.15	0.54	14
3	1.47	0.69	14
AVG	1.34	0.63	14

Catalyst Parameters

Test Run	Inlet Temp (°F)	DP (in H ₂ O)
1	773	14.2
2	774	14.2
3	776	14.2
AVG	774	14.2

Testing Protocol

The attached report was generated using an extractive FTIR system using methodologies as required by EPA 40 CFR 60 (A) Methods 1-3 and EPA 40 CFR 63 (A) Method 320 and/or ASTM D 6348-03.

Quality Assurance

Oasis has performed a full cursory review of the raw data and calculated results in this report. Any errors we have encountered have been listed in the body of this report. After performing the review, we are confident that this engine has met the requirements of the Consent Decree.

If you have any questions or require further information, please contact the undersigned at (307) 382-3297.

Yours truly,
Oasis Emission Consultants, Inc.



Christopher N. Knott, P.Eng.
Director, Engineering & Operations

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SOURCE EMISSION TEST REPORT

PERMIT EPA Consent Decree

Test Performed By: **Oasis Emission Consultants, Inc.**

Facility Name: **RBU 11-18F Facility**
Unit #3

Emission Source: **Caterpillar G3516LE**

Date of Test: **March 18, 2014**

Date of Report: **April 15, 2014**

1.1 Introduction

The purpose of this source test was to demonstrate that source emissions from a Caterpillar G3516LE engine do not exceed maximum allowable levels specified by guidelines issued in EPA's Consent Decree.

The Caterpillar G3516LE engine is a lean burn engine that employs an Oxidation Catalytic Convertor to regulate emission levels.

Three test runs were performed on March 18, 2014 to analyze NOx, CO & HCOH emission levels according to methodologies outlined in the ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320 Protocol. Effluent exhaust was sampled from the engine through an extractive heated stainless steel sample line interconnected to an MKS 2030 FTIR analyzer.

Each of the three runs consisted of sixty (60) readings taken at one (1) minute intervals.

Test runs were observed by the following individuals:

- Jeff Arsenault, Oasis Emission Consultants, Inc.
- Cole, XTO Energy, Inc.

2.1 Equipment Utilization

The following equipment was used during the tests performed at this facility in conjunction with procedures outlined by ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320.

- (1) MKS MultiGas 2030 FTIR Continuous Gas Analyzer
- (1) Laptop Computer For The FTIR Analyzer Using MKS MG2000 Software
- (1) 30ft or 100ft Heated Teflon Line w/ Heated Sample Probe & Spike Bypass Line
- (1) Fyrite O₂/CO₂ Analyzer
- (6) EPA Protocol G1 Calibration Gas (CO, NO_x, C₂H₄, CH₃CHO, C₃H₈ & NO₂)

The MKS Multigas 2030 FTIR Analyzer was used to measure NO_x & CO on a dry basis. Formaldehyde levels were measured on a wet basis and were corrected to produce levels on a dry basis. A pre Direct and System calibration measurement was made on compounds of NO_x, CO, CH₃CHO, C₃H₈ & C₂H₄. In addition, a post Direct calibration was made on compounds of NO_x, CO, CH₃CHO & C₃H₈. A post System calibration was also conducted for C₂H₄. Compounds of CO₂, CO, NO, CH₃CHO & C₃H₈ were measured for the quality assurance spiking requirements of ASTM D 6348-03 & EPA 40 CFR 63(A), Method 320

When a gas sample is introduced in the gas cell, the infrared beam is partially absorbed by the gas species present. The spectral frequencies absorbed and their intensity are due to the atoms associated with the chemical bond and the strength of that bond. The absorption spectrum is unique for each infrared-active gas. The MKS Analyzer measures the absorption spectrum, and its analysis algorithm measures the concentration of each gas using pre-loaded calibrations. The MG2000 software allows for the continuous measurement, display and recording of the sample stream.

The MKS Multigas 2030 FTIR Analyzer operated with a spectral resolution of 0.5 cm⁻¹ and a scan time of 30 seconds. The FTIR spectrometer utilizes a multi-pass gas cell with a 5.11 meter effective pathlength.

3.1 Discussion Of NO_x, CO & HCOH Test Results

Please refer to Appendix A for the raw NO_x, CO & HCOH test results. Please refer to Appendix B for a listing of all raw data, calibration error response and calculations performed per ASTM & EPA requirements. Overall the average emission levels complied with Consent Decree guidelines on a g/BHP-hr basis. Testing for NO_x, CO & HCOH were run concurrently with one another.

3.1.1 Source Test 1: Caterpillar G3516LE, NOx, CO & HCOH

The first test was performed from 14:21 to 15:20 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **1.12 g/BHP-hr and 0.01 g/BHP-hr** respectively. The Formaldehyde level was found to be **0.65 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (g/BHP-hr)	CO (ppm)	CO (g/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
1	163.15	1.12	1.81	0.01	1.39	0.65

3.1.2 Source Test 2: Caterpillar G3516LE, NOx, CO & HCOH

The second test was performed from 15:26 to 16:25 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **1.14 g/BHP-hr and 0.01 g/BHP-hr** respectively. The Formaldehyde level was found to be **0.54 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (g/BHP-hr)	CO (ppm)	CO (g/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
2	166.21	1.14	1.27	0.01	1.15	0.54

3.1.3 Source Test 3: Caterpillar G3516LE, NOx, CO & HCOH

The third test was performed from 16:31 to 17:30 for NOx, CO & HCOH.

The average NOx and CO levels were found to be **1.01 g/BHP-hr and 0.01 g/BHP-hr** respectively. The Formaldehyde level was found to be **0.69 ppm @ 15% O₂**, which tested in compliance with the current EPA standards.

Test Run	NOx (ppm)	NOx (g/BHP-hr)	CO (ppm)	CO (g/BHP-hr)	HCOH (ppm)	HCOH @ 15% O ₂ (ppm)
3	147.44	1.01	1.90	0.01	1.47	0.69

4.1 Stack Sampling Location

The sampling port for moisture, flow, NOx, CO and HCOH measurements was approximately 3' from the nearest upstream flow disturbance and 5' from the nearest downstream disturbance.

4.2 Stack Sampling Methods & Procedures

Testing followed EPA 40 CFR 63(A), Method 320 and/or ASTM D6348-03 methodologies per our standard protocol, with no exceptions.

5.1 Quality Assurance

CTS procedures were followed according to ASTM requirements for both pre and post testing. Similarly, QA spiking procedures were followed. Analysis of the CO₂ exhaust effluent was used to determine the dilution factor. Steady levels of the CO₂ were observed and a sufficient duration of time was allowed to elapse for a representative average.

The calibration gas was spiked into the effluent stream using a bypass line at approximately 10% of the sampling rate. The dilution factor was obtained from observation of the stack CO₂ behavior using the following equation:

$$DF = \frac{CO_2_{AVG} - CO_2_{SPIKE}}{CO_2_{AVG}}$$

Where: **CO₂Avg** = The average undiluted CO₂ stack gas concentration of spike measurements
CO₂SPIKE = The average diluted CO₂ stack gas concentration when spiked

The sample recovery was then obtained from the following equation:

$$\frac{\% REC = (Spike_{MEAS} - Stack_{MEAS}) * (1 - DF)}{CS * DF}$$

Where: **Spike_{MEAS}** = The average diluted stack gas concentration when spiked
Stack_{MEAS} = The average undiluted stack gas concentration
DF = Dilution factor
CS = Certified concentration of calibration standards

The Sample Recovery average level for CO, NO, C₃H₈ & CH₃CHO was found to be 95.0%, 91.9%, 95.0% & 110.8% respectively, which was within the allowable tolerance of Method 320 (70% to 130%). A summary of all spiking procedures/results can be found in Appendix B.

APPENDIX A

XTO Energy, Inc.						
RBU 11-18F #3						
Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	325.675336	2.146829	1.03988	12.750193	3/18/2014	14:21:28
2	325.322291	2.049591	1.080178	13.036474	3/18/2014	14:22:28
3	324.57572	2.070218	1.017274	12.830992	3/18/2014	14:23:28
4	326.039319	2.045211	1.144464	13.085769	3/18/2014	14:24:28
5	261.480419	1.886908	1.069318	13.086309	3/18/2014	14:25:28
6	211.338334	1.87749	1.20081	13.250247	3/18/2014	14:26:28
7	206.41848	2.048909	1.238706	12.937488	3/18/2014	14:27:28
8	164.675322	1.988642	1.267281	13.110936	3/18/2014	14:28:28
9	153.866338	2.011327	1.327921	13.673003	3/18/2014	14:29:28
10	150.666493	1.975029	1.692213	19.060211	3/18/2014	14:30:28
11	150.177464	2.059696	1.305356	13.060973	3/18/2014	14:31:28
12	149.159138	2.11373	1.330254	13.030627	3/18/2014	14:32:28
13	148.319553	2.119193	1.289557	12.99277	3/18/2014	14:33:28
14	151.039769	2.064388	1.308852	12.841989	3/18/2014	14:34:28
15	142.717721	2.104704	1.235876	12.965286	3/18/2014	14:35:28
16	150.550686	2.068051	1.264242	12.620211	3/18/2014	14:36:29
17	163.640642	2.024845	1.254942	12.511776	3/18/2014	14:37:29
18	159.918086	1.499993	1.099601	12.509488	3/18/2014	14:38:29
19	142.865562	1.332242	1.091987	12.423913	3/18/2014	14:39:29
20	137.457162	1.249799	1.058085	12.346655	3/18/2014	14:40:29
21	138.63367	1.130952	1.028522	11.775165	3/18/2014	14:41:29
22	133.044884	1.120943	0.971973	12.399361	3/18/2014	14:42:29
23	129.773395	1.021344	0.940535	12.112587	3/18/2014	14:43:29
24	127.938011	1.183857	1.027387	12.365591	3/18/2014	14:44:29
25	132.89849	1.340661	1.161782	12.913166	3/18/2014	14:45:29
26	145.475524	1.337913	1.093858	12.802249	3/18/2014	14:46:29
27	147.193968	1.171969	1.102942	14.54108	3/18/2014	14:47:29
28	133.216152	1.03319	0.990795	12.748256	3/18/2014	14:48:29
29	130.505105	1.075463	0.967493	12.561574	3/18/2014	14:49:29
30	127.408675	1.231926	1.008659	12.262256	3/18/2014	14:50:29
31	134.904179	1.49147	0.987517	10.970876	3/18/2014	14:51:29
32	139.654686	1.598437	1.032845	10.869206	3/18/2014	14:52:29
33	142.858652	1.64062	1.051951	11.381835	3/18/2014	14:53:29
34	146.224448	1.493703	1.053946	12.000779	3/18/2014	14:54:29
35	144.774736	1.490983	1.284455	14.4359	3/18/2014	14:55:29
36	139.523446	1.582502	1.181792	13.716119	3/18/2014	14:56:29
37	151.015434	1.864774	1.254746	13.566324	3/18/2014	14:57:29
38	161.856204	1.948582	1.355064	13.48954	3/18/2014	14:58:29
39	169.586298	2.088322	1.331189	13.002003	3/18/2014	14:59:29
40	152.080922	2.114073	1.333837	13.364869	3/18/2014	15:00:29
41	145.961647	2.02462	1.321094	12.996643	3/18/2014	15:01:29
42	147.331072	1.969807	1.290491	12.862862	3/18/2014	15:02:29
43	145.371678	2.05949	1.322407	12.843683	3/18/2014	15:03:29
44	142.735861	2.060224	1.306193	12.940677	3/18/2014	15:04:30
45	151.436536	2.067133	1.291373	12.833713	3/18/2014	15:05:30
46	147.065736	1.97174	1.326847	12.696488	3/18/2014	15:06:30
47	150.879327	2.062381	1.272218	12.539435	3/18/2014	15:07:30
48	149.375423	2.013236	1.34435	13.229253	3/18/2014	15:08:30
49	151.120789	2.027943	1.264283	12.819819	3/18/2014	15:09:30
50	154.307016	1.957395	1.235497	12.928018	3/18/2014	15:10:30
51	157.434301	1.991794	1.296042	13.113152	3/18/2014	15:11:30
52	157.76716	2.037548	1.281007	12.981262	3/18/2014	15:12:30
53	155.134063	2.102156	1.331537	13.069805	3/18/2014	15:13:30
54	155.270692	2.045757	1.250483	12.929344	3/18/2014	15:14:30
55	153.590478	2.041988	1.287544	13.497098	3/18/2014	15:15:30
56	152.161205	1.998646	1.304969	13.017639	3/18/2014	15:16:30
57	150.905742	2.036546	1.276632	12.746694	3/18/2014	15:17:30
58	150.552255	2.06898	1.311721	12.568238	3/18/2014	15:18:30
59	149.069039	2.068409	1.32616	12.531082	3/18/2014	15:19:30
60	146.836248	2.259896	1.345915	12.763555	3/18/2014	15:20:30
AVG	163.15	1.81	1.21	12.92		

Calculated Emission Levels					
NOx (g/BHP-hr)	NOx (lbs/hr)	CO (g/BHP-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
1.12	3.10	0.01	0.02	1.39	0.65

TEST RUN # 1

EPA REFERENCE METHOD 1		EPA REFERENCE METHOD 2						
Stack Diameter	12 Inches	Kp= 85.49 ft/sec				Cp= 0.84		
Traverse Points	16	Port	Point	Insertion Depth (inches)	dP (in h2O)	Ts (deg R)	Stat P (in H2O)	sqrt dP
Ports	2							
EPA REFERENCE METHOD 3		A	1	0.38	3.94	1205	1.71	1.985
Average O2	8.4 (% dry)	A	2	1.26	3.72	1205	1.71	1.929
Average CO2	7.5 (% dry)	A	3	2.33	3.44	1205	1.71	1.855
Average N2 + CO	84.1 (% dry)	A	4	3.88	3.09	1205	1.71	1.758
Dry Molecular Weight	29.54 lb/lbmol	A	5	8.12	3.11	1205	1.71	1.764
Wet Molecular Weight	28.05 lb/lbmol	A	6	9.67	3.35	1205	1.71	1.830
ASTM D6348-03 / EPA REFERENCE METHOD 320		A	7	10.74	3.68	1205	1.71	1.918
Barometric Pressure	24.85 in Hg	A	8	11.62	3.87	1205	1.71	1.967
Moisture Content	12.92 %	A	9					
ASTM D6348-03 / EPA REFERENCE METHOD 320		A	10					
Average Analyzer NOx Level	163.15 ppm	A	11					
Calculated NOx Mass Output	3.10 lbs/hr	A	12					
Calculated NOx Output	1.12 g/BHP-hr	A	13					
ASTM D6348-03 / EPA REFERENCE METHOD 320		A	14					
Average Analyzer CO Level	1.81 ppm	A	15					
Calculated CO Mass Output	0.02 lbs/hr	A	16					
Calculated CO Output	0.01 g/BHP-hr	B	1	0.38	3.87	1205	1.71	1.967
ASTM D6348-03 / EPA REFERENCE METHOD 320		B	2	1.26	3.69	1205	1.71	1.921
Average Analyzer HCOH Level (wet)	1.21 ppm	B	3	2.33	3.42	1205	1.71	1.849
Average Corrected HCOH Level (dry)	1.39 ppm	B	4	3.88	3.04	1205	1.71	1.744
Calculated HCOH @ 15% O2	0.65 ppm	B	5	8.12	3.09	1205	1.71	1.758
Calculated HCOH Mass Output	0.017 lbs/hr	B	6	9.67	3.38	1205	1.71	1.838
Calculated HCOH Output	0.006 g/BHP-hr	B	7	10.74	3.59	1205	1.71	1.895
LOAD APPROXIMATION		B	8	11.62	3.83	1205	1.71	1.957
Estimated Engine Load	1251.4 BHP	B	9					
		B	10					
		B	11					
		B	12					
		B	13					
		B	14					
		B	15					
		B	16					
Averages				3.51	1205	1.7	1.871	
Average Stack Gas Velocity				176.22	ft/sec			
Average Dry Flowrate				2644.89	dscfm			

XTO Energy, Inc.						
RBU 11-18F #3						
Run 2						
Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	139.611668	0.736368	0.834627	11.14855	3/18/2014	15:26:49
2	144.311874	0.599231	0.725597	11.535628	3/18/2014	15:27:49
3	169.389383	0.434235	0.669992	11.930268	3/18/2014	15:28:49
4	187.828983	0.28933	0.623794	12.444667	3/18/2014	15:29:49
5	198.15012	0.221118	0.536459	12.381521	3/18/2014	15:30:49
6	200.96854	0.148449	0.464568	12.553071	3/18/2014	15:31:49
7	205.61962	0.252461	0.493098	12.518954	3/18/2014	15:32:49
8	199.855681	0.190205	0.488492	12.433839	3/18/2014	15:33:49
9	197.4628	0.225218	0.490277	12.841226	3/18/2014	15:34:49
10	198.847811	0.209806	0.481627	13.143086	3/18/2014	15:35:49
11	191.189131	0.151659	0.444243	12.757814	3/18/2014	15:36:49
12	191.955067	0.222279	0.470867	12.772771	3/18/2014	15:37:50
13	190.575361	0.201094	0.507304	12.921476	3/18/2014	15:38:50
14	188.827228	0.227329	0.480772	12.778639	3/18/2014	15:39:50
15	184.689923	0.326422	0.550744	12.707068	3/18/2014	15:40:50
16	187.338026	0.256808	0.5317	13.173577	3/18/2014	15:41:50
17	183.479033	0.267465	0.509792	12.872656	3/18/2014	15:42:50
18	184.417602	0.201179	0.57379	12.961536	3/18/2014	15:43:50
19	185.941333	0.236847	0.512091	12.830113	3/18/2014	15:44:50
20	175.32795	0.258628	0.554485	12.988859	3/18/2014	15:45:50
21	159.24727	0.598416	0.789266	14.844454	3/18/2014	15:46:50
22	123.199254	0.887518	0.916809	13.170933	3/18/2014	15:47:50
23	126.521202	0.10197	0.963038	12.625546	3/18/2014	15:48:50
24	132.633151	1.210473	0.986669	12.717647	3/18/2014	15:49:50
25	139.834982	1.342803	1.053802	12.78245	3/18/2014	15:50:50
26	141.059698	1.396382	1.136866	13.004557	3/18/2014	15:51:50
27	148.276949	1.555885	1.12604	12.97241	3/18/2014	15:52:50
28	147.739267	1.613953	1.159979	13.035329	3/18/2014	15:53:50
29	151.243452	1.73596	1.16634	13.04817	3/18/2014	15:54:50
30	154.834487	1.649768	1.153517	12.859355	3/18/2014	15:55:50
31	153.306137	1.834379	1.168399	12.704492	3/18/2014	15:56:50
32	154.038771	1.761969	1.194135	12.696321	3/18/2014	15:57:50
33	155.504603	1.908407	1.178224	12.724877	3/18/2014	15:58:50
34	155.80918	1.81157	1.19565	13.089823	3/18/2014	15:59:50
35	153.937907	1.871066	1.230622	13.006331	3/18/2014	16:00:50
36	158.482921	1.756725	1.223053	13.273162	3/18/2014	16:01:50
37	160.924761	1.741215	1.23545	13.445676	3/18/2014	16:02:50
38	162.436629	1.8549	1.303757	13.600532	3/18/2014	16:03:50
39	168.66514	1.893732	1.274927	13.584503	3/18/2014	16:04:50
40	170.146474	1.85606	1.277828	13.370612	3/18/2014	16:05:50
41	175.420698	1.925518	1.256742	13.250558	3/18/2014	16:06:50
42	175.723685	1.926063	1.209639	13.002331	3/18/2014	16:07:50
43	171.251675	1.925326	1.239416	12.932819	3/18/2014	16:08:50
44	171.656379	1.904548	1.2157	13.05495	3/18/2014	16:09:50
45	171.016078	1.880139	1.288576	13.298852	3/18/2014	16:10:51
46	179.24006	1.96756	1.26395	12.965492	3/18/2014	16:11:51
47	184.533275	1.935255	1.298683	12.978035	3/18/2014	16:12:51
48	183.719654	2.047007	1.240326	13.10904	3/18/2014	16:13:51
49	156.694749	2.03417	1.32687	13.528045	3/18/2014	16:14:51
50	155.725303	2.066039	1.391921	13.987909	3/18/2014	16:15:51
51	156.744403	1.957248	1.391716	13.982475	3/18/2014	16:16:51
52	156.393222	2.107523	1.414474	13.596522	3/18/2014	16:17:51
53	149.165018	1.993205	1.411272	13.468721	3/18/2014	16:18:51
54	150.751253	2.050727	1.333812	13.658041	3/18/2014	16:19:51
55	144.036113	1.911083	1.333523	13.435217	3/18/2014	16:20:51
56	147.073354	1.978912	1.377325	13.4802	3/18/2014	16:21:51
57	154.491322	2.00143	1.349545	13.549775	3/18/2014	16:22:51
58	152.189836	1.968515	1.356894	13.523087	3/18/2014	16:23:51
59	155.03312	1.896962	1.294229	13.553983	3/18/2014	16:24:51
60	157.886419	1.877542	1.281458	13.531338	3/18/2014	16:25:51
AVG	166.21	1.27	1.00	13.04		

Calculated Emission Levels					
NOx (g/BHP-hr)	NOx (lbs/hr)	CO (g/BHP-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
1.14	3.14	0.01	0.01	1.15	0.54

TEST RUN # 2

EPA REFERENCE METHOD 1		EPA REFERENCE METHOD 2						
Stack Diameter	12 Inches	Kp= 85.49 ft/sec				Cp= 0.84		
Traverse Points	16	Port	Point	Insertion Depth (inches)	dP (in H ₂ O)	Ts (deg R)	Stat P (in H ₂ O)	sqrt dP
Ports	2	A	1	0.38	3.95	1206	1.71	1.987
EPA REFERENCE METHOD 3		A	2	1.26	3.71	1206	1.71	1.926
Average O ₂	8.4 (% dry)	A	3	2.33	3.44	1206	1.71	1.855
Average CO ₂	7.5 (% dry)	A	4	3.88	3.06	1206	1.71	1.749
Average N ₂ + CO	84.1 (% dry)	A	5	8.12	3.12	1206	1.71	1.766
Dry Molecular Weight	29.54 lb/lbmol	A	6	9.67	3.37	1206	1.71	1.836
Wet Molecular Weight	28.03 lb/lbmol	A	7	10.74	3.64	1206	1.71	1.908
ASTM D6348-03 / EPA REFERENCE METHOD 320		A	8	11.62	3.89	1206	1.71	
Barometric Pressure	24.82 in Hg	A	9					
Moisture Content	13.04 %	A	10					
ASTM D6348-03 / EPA REFERENCE METHOD 320		A	11					
Average Analyzer NO _x Level	166.21 ppm	A	12					
Calculated NO _x Mass Output	3.14 lbs/hr	A	13					
Calculated NO _x Output	1.14 g/BHP-hr	A	14					
ASTM D6348-03 / EPA REFERENCE METHOD 320		B	1	0.38	3.89	1206	1.71	1.972
Average Analyzer CO Level	1.27 ppm	B	2	1.26	3.66	1206	1.71	1.913
Calculated CO Mass Output	0.01 lbs/hr	B	3	2.33	3.45	1206	1.71	1.857
Calculated CO Output	0.01 g/BHP-hr	B	4	3.88	3.05	1206	1.71	1.746
ASTM D6348-03 / EPA REFERENCE METHOD 320		B	5	8.12	3.07	1206	1.71	1.752
Average Analyzer HCOH Level (wet)	1.00 ppm	B	6	9.67	3.34	1206	1.71	1.828
Average Corrected HCOH Level (dry)	1.15 ppm	B	7	10.74	3.59	1206	1.71	1.895
Calculated HCOH @ 15% O ₂	0.54 ppm	B	8	11.62	3.85	1206	1.71	1.962
Calculated HCOH Mass Output	0.014 lbs/hr	B	9					
Calculated HCOH Output	0.005 g/BHP-hr	B	10					
LOAD APPROXIMATION		B	11					
Estimated Engine Load	1248.8 BHP	B	12					
		B	13					
		B	14					
		B	15					
		B	16					
Averages				3.51	1206	1.7	1.864	
Average Stack Gas Velocity				175.75	ft/sec			
Average Dry Flowrate				2628.99	dscfm			

XTO Energy, Inc.						
RBU 11-18F #3						
Run 3						
Record	FTIR Measurements				Date	Time
	NOx Dry	CO ppm Dry	Formaldehyde 191C Wet	H2O% (High) 191C		
1	155.154962	1.874983	1.280254	12.995225	3/18/2014	16:31:36
2	149.666262	1.921627	1.348401	13.065645	3/18/2014	16:32:36
3	148.194925	1.884912	1.286518	12.99321	3/18/2014	16:33:36
4	150.240819	1.983608	1.279163	13.181933	3/18/2014	16:34:36
5	148.413367	1.955191	1.252724	12.971932	3/18/2014	16:35:36
6	149.133078	1.990168	1.258439	13.15634	3/18/2014	16:36:36
7	153.132277	1.84476	1.290325	12.987402	3/18/2014	16:37:36
8	157.944139	1.962819	1.265893	13.176547	3/18/2014	16:38:37
9	155.145496	1.934603	1.330615	12.980797	3/18/2014	16:39:37
10	155.328361	1.92561	1.249185	13.123225	3/18/2014	16:40:37
11	151.502469	1.9551	1.229711	12.921096	3/18/2014	16:41:37
12	152.07686	2.025347	1.271643	13.0953	3/18/2014	16:42:37
13	146.563488	1.908225	1.236991	12.984105	3/18/2014	16:43:37
14	143.462878	1.997044	1.252531	12.889559	3/18/2014	16:44:37
15	148.628318	1.977243	1.324392	12.928671	3/18/2014	16:45:37
16	152.823432	1.981645	1.316745	13.079191	3/18/2014	16:46:37
17	149.127886	2.044202	1.28376	12.917226	3/18/2014	16:47:37
18	147.957548	1.974342	1.209454	12.927582	3/18/2014	16:48:37
19	148.564515	2.122105	1.323418	12.984272	3/18/2014	16:49:37
20	146.119251	2.009771	1.286652	12.589194	3/18/2014	16:50:37
21	151.118784	2.072718	1.324388	12.983723	3/18/2014	16:51:37
22	168.054344	1.940864	1.308049	12.498886	3/18/2014	16:52:37
23	165.825193	1.648784	1.195897	12.157462	3/18/2014	16:53:37
24	144.163816	1.450321	1.087299	11.799516	3/18/2014	16:54:37
25	144.677034	1.502579	1.077718	11.623574	3/18/2014	16:55:37
26	149.356649	1.596919	1.12575	11.559395	3/18/2014	16:56:37
27	150.969294	1.595845	1.182493	12.165994	3/18/2014	16:57:37
28	151.770774	1.628072	1.14784	12.489613	3/18/2014	16:58:37
29	156.785831	1.737196	1.184753	12.90291	3/18/2014	16:59:37
30	162.944965	1.83241	1.280122	12.98446	3/18/2014	17:00:37
31	153.136842	1.923522	1.296426	13.096904	3/18/2014	17:01:38
32	141.175363	1.912237	1.331493	12.862314	3/18/2014	17:02:37
33	143.838688	1.907202	1.334415	12.83878	3/18/2014	17:03:37
34	143.629977	2.019219	1.293659	12.927215	3/18/2014	17:04:38
35	140.397917	1.981909	1.300472	13.21083	3/18/2014	17:05:38
36	143.429195	1.85551	1.280555	13.18275	3/18/2014	17:06:38
37	145.683977	1.869543	1.285692	13.400373	3/18/2014	17:07:38
38	146.456119	1.861809	1.333466	13.500164	3/18/2014	17:08:38
39	145.817066	1.890552	1.303484	12.809886	3/18/2014	17:09:38
40	141.503911	1.864736	1.276698	12.80851	3/18/2014	17:10:38
41	142.265942	1.87533	1.248311	13.217444	3/18/2014	17:11:38
42	142.293497	1.901883	1.280999	13.445006	3/18/2014	17:12:38
43	141.242391	1.998508	1.305181	13.463517	3/18/2014	17:13:38
44	142.448491	1.937359	1.353841	13.953399	3/18/2014	17:14:38
45	140.671836	1.917602	1.40499	13.881041	3/18/2014	17:15:38
46	141.93682	1.977732	1.361678	13.467509	3/18/2014	17:16:38
47	142.529653	1.958014	1.349239	13.164397	3/18/2014	17:17:38
48	137.894703	1.994365	1.27473	13.196848	3/18/2014	17:18:38
49	143.141494	2.054004	1.325142	13.081619	3/18/2014	17:19:38
50	137.830667	1.887141	1.334333	12.714707	3/18/2014	17:20:38
51	141.968361	1.962179	1.297946	12.480005	3/18/2014	17:21:38
52	147.078143	1.989541	1.236617	12.44619	3/18/2014	17:22:38
53	145.534758	1.934093	1.22107	12.573871	3/18/2014	17:23:38
54	141.065371	1.862946	1.26643	13.054997	3/18/2014	17:24:38
55	143.798222	1.967332	1.324942	12.936251	3/18/2014	17:25:38
56	143.733336	1.983842	1.290328	13.001019	3/18/2014	17:26:38
57	144.839671	1.876701	1.345712	13.127589	3/18/2014	17:27:39
58	142.637751	1.914802	1.409599	12.913849	3/18/2014	17:28:39
59	141.391343	1.93429	1.330487	12.707733	3/18/2014	17:29:39
60	142.092331	1.946064	1.313884	12.796418	3/18/2014	17:30:39
AVG	147.44	1.90	1.28	12.92		

Calculated Emission Levels					
NOx (g/BHP-hr)	NOx (lbs/hr)	CO (g/BHP-hr)	CO (lbs/hr)	HCOH Dry (ppm)	HCOH @ 15% O2 (ppm)
1.01	2.79	0.01	0.02	1.47	0.69

TEST RUN # 3

EPA REFERENCE METHOD 1		EPA REFERENCE METHOD 2																				
Stack Diameter	12 Inches	Kp= 85.49 ft/sec			Cp= 0.84			Port	Point	Insertion Depth (inches)	dP (in h2O)	Ts (deg R)	Stat P (in H2O)	sqrt dP								
Traverse Points	16																					
Ports																						
EPA REFERENCE METHOD 3																						
Average O2	8.4 (% dry)	A	2	0.38	3.90	1206	1.71	1.975														
Average CO2	7.5 (% dry)	A	3	1.26	3.70	1206	1.71	1.924														
Average N2 + CO	84.1 (% dry)	A	4	2.33	3.40	1206	1.71	1.844														
Dry Molecular Weight	29.54 lb/lbmol	A	5	3.88	3.00	1206	1.71	1.732														
Wet Molecular Weight	28.05 lb/lbmol	A	6	8.12	3.10	1206	1.71	1.761														
ASTM D6348-03 / EPA REFERENCE METHOD 320														1.897								
Barometric Pressure	24.83 in Hg	A	7	9.67	3.30	1206	1.71	1.817														
Moisture Content	12.92 %	A	8	10.74	3.60	1206	1.71	1.897														
ASTM D6348-03 / EPA REFERENCE METHOD 320														1.949								
Average Analyzer NOx Level	147.44 ppm	A	9																			
Calculated NOx Mass Output	2.79 lbs/hr	A	10																			
Calculated NOx Output	1.01 g/BHP-hr	A	11																			
ASTM D6348-03 / EPA REFERENCE METHOD 320																						
Average Analyzer CO Level	1.90 ppm	B	1	0.38	3.88	1206	1.71	1.970														
Calculated CO Mass Output	0.02 lbs/hr	B	2	1.26	3.68	1206	1.71	1.918														
Calculated CO Output	0.01 g/BHP-hr	B	3	2.33	3.41	1206	1.71	1.847														
ASTM D6348-03 / EPA REFERENCE METHOD 320																						
Average Analyzer HCOH Level (wet)	1.28 ppm	B	4	3.88	3.06	1206	1.71	1.749														
Average Corrected HCOH Level (dry)	1.47 ppm	B	5	8.12	3.08	1206	1.71	1.755														
Calculated HCOH @ 15% O2	0.69 ppm	B	6	9.67	3.39	1206	1.71	1.841														
Calculated HCOH Mass Output	0.018 lbs/hr	B	7	10.74	3.55	1206	1.71	1.884														
Calculated HCOH Output	0.007 g/BHP-hr	B	8	11.62	3.84	1206	1.71	1.960														
LOAD APPROXIMATION																						
Estimated Engine Load	1250.0 BHP	B	9																			
		B	10																			
		B	11																			
		B	12																			
		B	13																			
		B	14																			
		B	15																			
		B	16																			
Averages							3.48	1206	1.7	1.864												
Average Stack Gas Velocity							175.70	ft/sec														
Average Dry Flowrate							2632.78	dscfm														

APPENDIX B

Raw Calibration Data

BACKGROUND

Date	Time	NO 191C span	NO2 191C span	H2O% (high) 191C	Formaldehyde 191C	Ethylene 191C TE span	Propane 191C span	Acetaldehyde 191C span	CO ppm 191C (10f2) span	CO ppm Dry	CO2% 191C	NOx Wet	NOx Dry	NM NE HC C3
3/18/2014	13:38:28	-0.226467	0.014039	0.014574	-0.110925	0.124953	0.783896	0.581984	0.027524	0.027528	0.006985	-0.212459	0.333182	
3/18/2014	13:38:33	0.016215	0.234407	0.0092	0.084467	-0.071088	-0.396488	1.235078	0.040587	0.040593	0.030885	0.250623	0.250846	
3/18/2014	13:39:41	0	0	0	0	0	0	0	0	0	0	0	0	0.381982
3/18/2014	13:39:55	-0.235853	-0.028189	0.001204	0.073771	-0.409809	-0.531087	-0.418411	-0.181427	-0.181429	-0.003689	-0.284022	-0.284025	0.000000
3/18/2014	13:40:02	-0.049328	0.083312	0.000488	-0.077815	0.105011	-0.435337	0.854591	-0.123295	-0.123296	-0.0091	0.013984	0.013984	0.022952
3/18/2014	13:40:09	0.020998	0.000298	0.094498	0.001381	0.151462	-0.395107	0.020034	-0.303826	-0.303826	-0.003689	0.094564	0.094565	0.000001
3/18/2014	13:40:17	0.074431	0.11	-0.012158	0.130938	-0.388298	-0.798164	-0.157719	-0.068544	-0.068543	-0.007502	0.188431	0.188429	0.007434
3/18/2014	13:40:25	-0.144079	-0.003058	4.09309	-0.008028	-0.327988	0.827734	0.130352	0.041998	0.041998	-0.003689	-0.179137	-0.179127	0.248184
3/18/2014	13:40:32	0.103271	0.010371	0.000983	-0.008083	-0.087288	-0.078932	0.743119	-0.177949	-0.177951	-0.003689	0.131965	0.131964	0.000000
3/18/2014	13:40:39	-0.031893	0.030208	0.005274	-0.00566	-0.183717	-0.370877	0.03785	0.057108	0.057109	0.0057109	-0.001786	-0.001786	0.220886
3/18/2014	13:40:47	-0.140521	0.08611	0.000536	-0.016979	0.940277	0.120807	0.185041	-0.008601	-0.008601	-0.008601	-0.074411	-0.074411	0.006127
3/18/2014	13:40:55	-0.059594	-0.002381	-0.003928	0.238115	0.421978	-1.194703	-0.079315	-0.098044	-0.098044	-0.075311	-0.056313	-0.056313	0.092520

PRE DIRECT CAL

Date	Time	CO ppm 191C (10f2) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Ethylene 191C TE	Date	Time	Acetaldehyde 191C span
3/18/2014	13:41:02	38.53321	43.776203	37.313434	3/18/2014	13:44:36	-0.792754	3/18/2014	13:42:00	-0.39284			
3/18/2014	13:41:10	345.97051	351.28343	323.308541	3/18/2014	13:44:43	-0.279204	3/18/2014	13:42:07	1.157105			
3/18/2014	13:41:17	481.922825	486.803193	485.945025	3/18/2014	13:44:51	10.990748	3/18/2014	13:42:14	19.131965			
3/18/2014	13:41:25	494.284909	498.522442	475.980399	3/18/2014	13:44:59	73.280705	3/18/2014	13:42:22	28.583788			
					3/18/2014	13:45:06	98.218318	3/18/2014	13:42:29	29.386133			
					3/18/2014	13:45:14	99.045234	3/18/2014	13:42:37	30.517272			
					3/18/2014	13:45:21	100.128899						
					3/18/2014	13:45:29	100.200000						
					3/18/2014	13:45:36	100.441682						
					3/18/2014	13:45:44	99.680874						
					3/18/2014	13:45:51	100.315949						
					3/18/2014	13:45:59	99.535874						
					3/18/2014	13:46:06	99.685879						

NO2 CAL

Date	Time	NO2 191C span
3/18/2014	13:43:12	-0.055877
3/18/2014	13:43:19	29.879839
3/18/2014	13:43:27	128.953157
3/18/2014	13:43:34	141.035539
3/18/2014	13:43:42	142.035539
3/18/2014	13:43:49	143.77407
3/18/2014	13:43:57	144.09247
3/18/2014	13:44:04	144.829859

PRE SYSTEM CAL

Date	Time	CO ppm 191C (10f2) span	NOx Wet	Propane 191C span	Date	Time	Ethylene 191C TE	Date	Time	Ethylene 191C TE	Date	Time	Acetaldehyde 191C span
3/18/2014	13:52:58	68.572929	204.449577	68.550000	3/18/2014	13:55:00	-0.800000	3/18/2014	13:54:14	8.253379			
3/18/2014	13:53:05	453.589589	459.102878	436.987248	3/18/2014	13:55:07	88.795752	3/18/2014	13:54:21	27.541915			
3/18/2014	13:53:13	477.132749	480.410212	462.790968	3/18/2014	13:55:15	96.777218	3/18/2014	13:54:29	29.481248			
3/18/2014	13:53:21	479.410503	483.832892	468.623978	3/18/2014	13:55:23	98.294696						
3/18/2014	13:53:28	481.815042	486.118222	469.955815	3/18/2014	13:55:30	99.090412						
3/18/2014	13:53:36	482.400754	486.549335	468.392254	3/18/2014	13:55:38	98.830814						
3/18/2014	13:53:43	483.148979	486.635313	468.98024	3/18/2014	13:55:45	97.781209						
					3/18/2014	13:55:53	98.110261						
					3/18/2014	13:56:00	99.0707						
					3/18/2014	13:56:08	98.356695						
					3/18/2014	13:56:15	99.148299						

SAMPLE SPIKE RECOVERY

Date	Time	CO2% 191C	CO ppm 191C (1e12) span	NO 191C span	Propane 191C span
3/18/2014	14:02:36	6.992477	0.428095	208.4402	5.32485
3/18/2014	14:02:58	6.919715	1.287207	197.19128	4.658625
3/18/2014	14:03:06	6.888286	1.045814	190.97839	4.772713
3/18/2014	14:03:13	6.850632	1.155438	175.39785	5.433728
3/18/2014	14:03:21	3.299972	0.471883	83.35297	2.998692
3/18/2014	14:03:28	0.512179	99.41547	125.95416	88.796404
3/18/2014	14:03:36	0.288635	413.401917	415.721848	399.809058
3/18/2014	14:03:43	4.389285	140.613018		134.788942
3/18/2014	14:03:51	8.224982	45.520398	165.720795	47.219399
3/18/2014	14:03:58	8.253712	43.891342	194.112903	45.837975
3/18/2014	14:04:06	6.228579	44.085177	199.520212	46.394085
3/18/2014	14:04:13	6.220842	44.781478	207.724279	47.124413
3/18/2014	14:04:21	6.281071	43.777761	214.705783	45.55672
3/18/2014	14:04:28	6.281847	41.284108	213.174277	43.732194
3/18/2014	14:04:35	6.282193	40.339985	214.348513	42.476732
3/18/2014	14:04:43	6.302635	40.540283	211.230131	42.194395
3/18/2014	14:05:08	8.314898	31.520356	197.507983	34.275162
3/18/2014	14:05:13	8.352547	30.123049	202.005553	34.70525
3/18/2014	14:05:21	8.436896	32.188665	207.858385	34.277158
3/18/2014	14:05:28	8.452031	32.189049	214.43468	34.527802
3/18/2014	14:05:36	8.359454	32.428908	204.595281	34.524102
3/18/2014	14:05:43	8.37812	31.800785	200.098179	34.377173
3/18/2014	14:05:51	8.325982	39.009806	214.470117	41.334317
3/18/2014	14:05:58	8.292429	42.189538	218.442331	43.334139
3/18/2014	14:06:36	8.787482	2.123981	179.358562	4.680592
3/18/2014	14:08:43	8.909833	1.19244	186.868681	5.464049
3/18/2014	14:07:26	8.856095	2.120178	197.201841	5.464049
3/18/2014	14:07:13	8.908624	2.014192	205.093817	5.494833
3/18/2014	14:07:21	6.642504	13.584289	206.527229	16.252843
3/18/2014	14:07:28	1.061969	368.734714	389.349044	346.899043
3/18/2014	14:07:36	0.08134	439.525205	438.342258	427.278621
3/18/2014	14:07:43	0.102104	449.880528	451.021582	432.139338
3/18/2014	14:07:51	4.922698	119.277708	298.703554	116.682035
3/18/2014	14:07:58	6.313493	44.6177	219.337452	46.592491
3/18/2014	14:08:05	8.343864	41.325568	213.92235	43.580628
3/18/2014	14:08:13	8.327073	41.479023	214.3977	43.580628
3/18/2014	14:08:21	6.255912	47.531948	232.174432	49.182153
3/18/2014	14:08:36	6.215781	49.987432	222.159085	50.909807
3/18/2014	14:08:51	6.179885	50.229004	216.272658	52.356888
3/18/2014	14:08:58	8.18941	49.574078	210.214282	51.962402
3/18/2014	14:09:05	8.154292	49.500827	214.433048	51.293025
3/18/2014	14:09:13	8.278874	43.918701	215.299447	46.411708
3/18/2014	14:09:43	6.310239	41.3252	216.8117256	42.34274

ACETALDEHYDE SPIKE RECOVERY

Date	Time	CO2% 191C	Acetaldehyde 191C span
3/18/2014	13:57:52	7.130322	-0.745229
3/18/2014	13:58:07	7.112935	-1.090051
3/18/2014	13:58:22	7.109612	-0.990332
3/18/2014	13:58:29	7.142588	-0.957974
3/18/2014	13:58:37	7.121739	-1.123993
3/18/2014	13:58:44	5.698436	0.036891
3/18/2014	13:58:52	0.462355	11.683703
3/18/2014	13:58:59	0.246426	28.872485
3/18/2014	13:59:07	0.188911	28.251911
3/18/2014	13:59:14	5.448328	6.460117
3/18/2014	13:59:22	6.585191	1.948651
3/18/2014	13:59:29	6.802101	2.387392
3/18/2014	13:59:37	6.548753	2.27307
3/18/2014	13:59:45	6.403785	2.728351
3/18/2014	13:59:52	6.240225	2.787893
3/18/2014	13:59:59	6.164086	3.140981
3/18/2014	14:00:07	6.223265	2.905731
3/18/2014	14:00:14	6.50114	1.956938
3/18/2014	14:00:22	6.580473	1.811898
3/18/2014	14:00:29	6.580992	1.801525
3/18/2014	14:00:37	6.374198	2.285868
3/18/2014	14:00:44	6.361886	2.383956
3/18/2014	14:00:52	6.407858	2.186487
3/18/2014	14:01:07	6.432952	1.887852

POST DIRECT CAL

Date	Time	CO ppm 191C (1e12) span	NOx Wet	Propane 191C span	Date	Time	Acetaldehyde 191C span
3/18/2014	17:37:09	0.085205	-0.123045	-0.401295	3/18/2014	17:38:19	1.548891
3/18/2014	17:37:16	19.530082	21.335528	18.833278	3/18/2014	17:38:27	10.092872
3/18/2014	17:37:24	308.307592	308.201169	280.814539	3/18/2014	17:38:34	28.881442
3/18/2014	17:37:31	466.793148	467.814028	441.054822	3/18/2014	17:38:42	30.021673
3/18/2014	17:37:39	484.516026	497.568188	470.052381			
3/18/2014	17:37:46	499.466501	502.169896	477.1477			

POST SYSTEM CAL

Date	Time	Ethylene 191C TE
3/18/2014	17:34:18	71.398277
3/18/2014	17:34:25	95.581328
3/18/2014	17:34:33	97.576324
3/18/2014	17:34:40	98.559794
3/18/2014	17:34:48	98.559941
3/18/2014	17:34:55	98.501523
3/18/2014	17:35:03	98.819968
3/18/2014	17:35:10	98.870298
3/18/2014	17:35:18	98.773168

FTIR QA/QC SUMMARY

Period	Spike #	SAMPLE RECOVERY CALCULATIONS														
		Concentration of CO Cylinder	Concentration of Propane Cylinder	Concentration of NO Cylinder	Stack CO2 Concentration	Stack CO Concentration	Stack NO Concentration	Stack Propane Concentration	Stack + Spike CO2 Concentration	Stack + CO Concentration	Stack + NO Concentration	Stack + Propane Concentration	DF Calculated	% Recovery CO	% Recovery NO	% Recovery Propane
PRE TEST	1	499.5	479.9	496.3	6.9	1.1	192.4	5.0	6.3	46.0	217.5	47.8	0.095	95.0%	91.9%	95.0%

ACETALDEHYDE SAMPLE RECOVERY CALCULATIONS								
Period	Spike #	Concentration of CH3CHO Cylinder	Stack CO2 Concentration	Stack CH3CHO Concentration	Stack + Spike CO2 Concentration	Stack + CH3CHO Concentration	DF Calculated	% Recovery CH3CHO
PRE TEST	1	30.0	7.1	-1.0	6.4	2.3	0.098	110.8%

PRE SYSTEM CAL			
Sensor	System Response (ppm)	Cal Level (ppm)	Cal Recovery (%)
NOx	485.6	496.3	-2.1
CO	483.1	499.5	-3.3
Propane	469.0	479.9	-2.3
*Ethylene	99.1	100.0	-0.9
Acetaldehyde	29.5	30.0	-1.8

PRE DIRECT CAL					
Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)	Zero Error (%)
NOx	498.5	496.3	0.4	0.4	0.1
CO	494.3	499.5	-0.1	-1.0	-0.01
Propane	476.0	479.9	0.4	-0.8	0.1
Ethylene	99.7	100.0	-0.4	-0.3	-0.4
Acetaldehyde	30.5	30.0	-0.4	1.7	-1.4

POST DIRECT CAL					
Sensor	Analyzer Response (ppm)	Cal Level (ppm)	Zero Response (ppm)	Cal Error (%)	Zero Error (%)
NOx	502.2	496.3	0.3	1.2	0.1
CO	499.5	499.5	0.1	-0.01	0.02
Propane	477.1	479.9	0.4	-0.6	0.1
Acetaldehyde	30.0	30.0	0.4	0.04	1.4

POST SYSTEM CAL			
Sensor	System Response (ppm)	Cal Level (ppm)	Cal Recovery (%)
*Ethylene	99.8	100.0	-0.2

*CTS Scans are conducted with Ethylene through the sample line.

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E05NI99E15A0000
 Cylinder Number: SG9173615BAL
 Laboratory: ASG - Chicago - IL
 PGVP Number: B12013
 Gas Code: CH4,CO,NO,PPN,BALN

Reference Number: 54-124397019-1
 Cylinder Volume: 144.4 CF
 Cylinder Pressure: 2015 PSIG
 Valve Outlet: 660
 Certification Date: Oct 04, 2013

Expiration Date: Oct 04, 2021

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	500.0 PPM	496.4 PPM	G1	+/- 0.8% NIST Traceable	09/30/2013, 09/23/2013
CARBON MONOXIDE	500.0 PPM	499.5 PPM	G1	+/- 1.0% NIST Traceable	09/30/2013
METHANE	500.0 PPM	512.5 PPM	G1	+/- 1.0% NIST Traceable	10/02/2013
NITRIC OXIDE	500.0 PPM	496.3 PPM	G1	+/- 0.8% NIST Traceable	09/30/2013, 09/23/2013
PROPANE	500.0 PPM	479.9 PPM	G1	+/- 1% NIST Traceable	10/04/2013
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
CO	12062424	CC366872	487.1 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 22, 2018
CH4	10060909	CC320616	500.5 PPM METHANE/NITROGEN	+/- 0.6%	Aug 07, 2016
NTRM/NO	12061034	CC359504	500.7 PPM NITRIC OXIDE/NITROGEN	+/- 0.5%	Feb 16, 2018
NO2	124206889130	CC323209	4.824 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Oct 25, 2015
NTRM	10060514	CC281296	495.3 PPM PROPANE/AIR	+/- 0.5%	Feb 19, 2016

ANALYTICAL EQUIPMENT			
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration	
Nexus 470 AEP0000428	FTIR	Sep 21, 2013	
Nicolet 6700 AHR0801332	FTIR	Sep 22, 2013	
Nexus 470 AEP0000428	FTIR	Sep 21, 2013	
Nexus 470 AEP0000428	FTIR	Sep 21, 2013	
MKS Multigas 17707558	FTIR	Sep 09, 2013	

Triad Data Available Upon
Request

Notes:

Airgas Specialty Gases

12722 South Wentworth Avenue

Chicago, IL 60628

(773) 785-3000 Fax: (773) 785-1928

www.airgas.com

CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E03NI99E15A2059
Cylinder Number: SG9152728BAL
Laboratory: ASG - Chicago - IL
PGVP Number: B12013
Gas Code: NO₂,O₂,BALN

Reference Number: 54-124385551-1
Cylinder Volume: 144.4 Cubic Feet
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Jul 26, 2013

Expiration Date: Jul 26, 2016

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a volume/volume basis unless otherwise noted.

Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NITROGEN DIOXIDE	150.0 PPM	149.8 PPM	G1	+/- 2.0%	07/19/2013, 07/26/2013
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
GMIS/NO ₂	124320129107	CC411587	195.2 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.1%	Sep 27, 2015
PRM	12315	726637	250.1 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.0%	Mar 15, 2013

The SRM or PRM noted above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT					
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration			
MKS Multigas 17707558	FTIR	Jul 10, 2013			

Triad Data Available Upon Request

Notes:

Approved for Release

Airgas Specialty Gases

12722 South Wentworth Avenue

Chicago, IL 60628

(773)785-3000 Fax: (773) 785-1928

www.airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: PRIMARY STANDARD

Part Number: X02NI99P15AD524
Cylinder Number: XC011295B
Laboratory: ASG - Chicago - IL
Analysis Date: May 23, 2013
Lot Number: 54-124375956-1

Reference Number: 54-124375956-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 350

Primary Standard Gas Mixtures are traceable to N.I.S.T. weights and/or N.I.S.T. Gas Mixture reference materials.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
ETHYLENE	100.0 PPM	100.1 PPM	+/- 1.0%
NITROGEN	Balance		

Notes:


Approved for Release

CERTIFICATE OF ANALYSIS

Grade of Product: CERTIFIED STANDARD-SPEC

Part Number: X02NI99C15AC0A0 Reference Number: 83-124358586-1
Cylinder Number: CC70310 Cylinder Volume: 144.4 CF
Laboratory: ASG - Port Allen - LA Cylinder Pressure: 2015 PSIG
Analysis Date: Mar 15, 2013 Valve Outlet: 350
Lot Number: 83-124358586-1

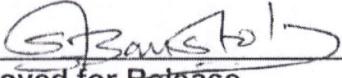
Expiration Date: Mar 15, 2014

Product composition verified by direct comparison to calibration standards traceable to N.I.S.T. weights and/or N.I.S.T.
Gas Mixture reference materials.

ANALYTICAL RESULTS

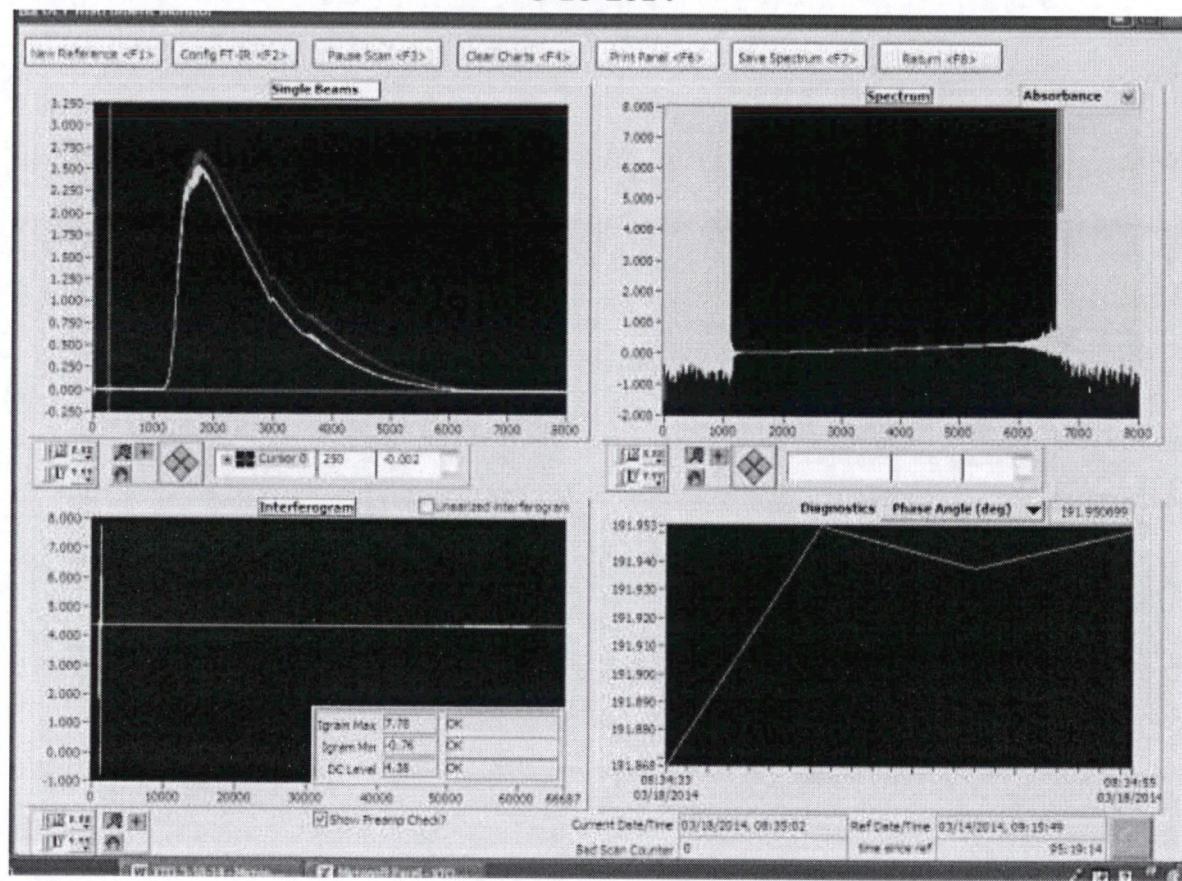
Component	Requested Concentration	Actual Concentration (Mole %)	Analytical Uncertainty
ACETALDEHYDE	30.00 PPM	30.01 PPM	+/- 5%
NITROGEN	Balance		

Notes:


Approved for Release

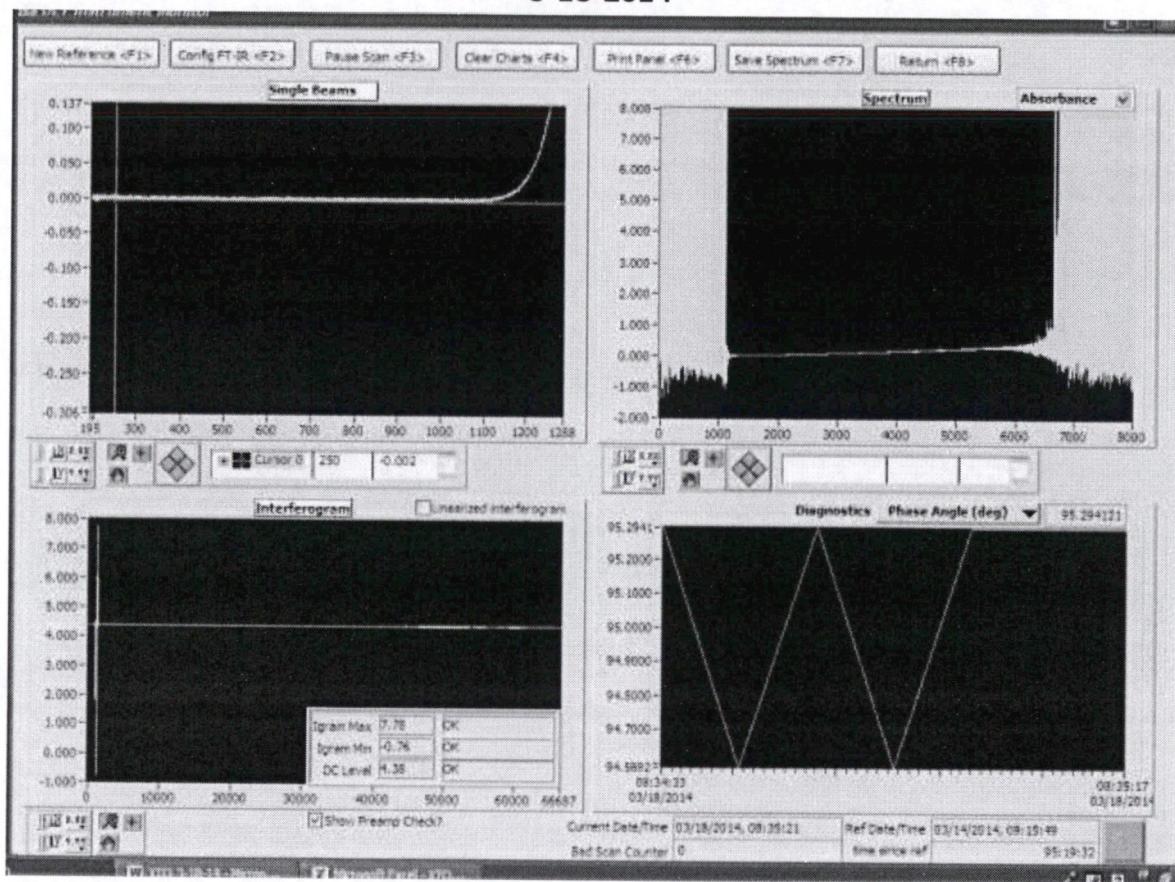
XTO – RBU 11-18F #3

3-18-2014

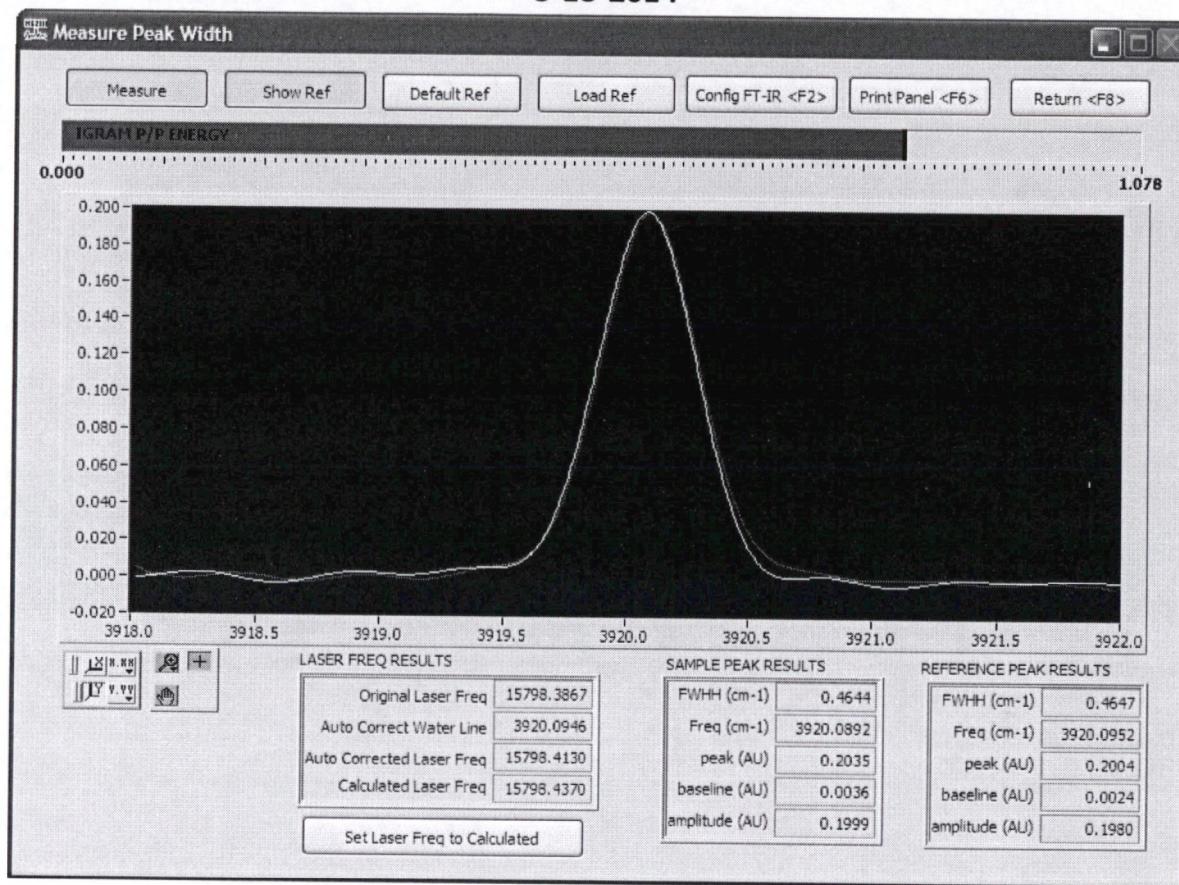


XTO – RBU 11-18F #3

3-18-2014



XTO – RBU 11-18F #3
3-18-2014



Instrument Resolution – FWHH – 0.4644 cm⁻¹ which is < 0.55 cm⁻¹ (therefore meets ASTM)
Water Frequency – Freq – 3920.0892 cm⁻¹ which is +/- 0.075 of 3920.0952 cm⁻¹ (therefore meets ASTM)

Please note: FWHH is the Full Width at Half Height of the resolution. The frequency position is only calculating the center line for one water line in the spectrum. MKS uses 3920.0952 cm⁻¹ since it is a single water line.

CO/NO/NO₂/Formaldehyde FTIR Instrument Noise-Limited Minimum Detectable Concentration - MDC#2

Noise Equivalent Absorbance Data				
Spectrum	CO	NO	NO ₂	Formaldehyde
XTO RBU 11-18 #3 3-18-14_000004.LAB	-0.18	-0.24	-0.03	0.07
XTO RBU 11-18 #3 3-18-14_000005.LAB	-0.12	-0.05	0.06	-0.08
XTO RBU 11-18 #3 3-18-14_000006.LAB	-0.30	0.03	0.06	0.15
XTO RBU 11-18 #3 3-18-14_000007.LAB	-0.07	0.07	0.11	0.13
XTO RBU 11-18 #3 3-18-14_000008.LAB	0.04	-0.14	-0.04	-0.06
XTO RBU 11-18 #3 3-18-14_000009.LAB	-0.17	0.10	0.01	0.00
XTO RBU 11-18 #3 3-18-14_000010.LAB	0.06	-0.03	0.03	-0.01
XTO RBU 11-18 #3 3-18-14_000011.LAB	-0.01	-0.14	0.07	-0.02
XTO RBU 11-18 #3 3-18-14_000012.LAB	-0.10	-0.06	0.00	0.24
Noise Equivalent Absorbance (Standard Deviation)	0.11	0.10	0.05	0.10
MDC #2	0.33	0.31	0.14	0.30

APPENDIX C

G3516

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - RBU 11-18F #3



ENGINE SPEED (rpm):	1330	RATING STRATEGY:		STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:		CONTINUOUS
AFTERCooler TYPE:	SCAC	FUEL SYSTEM:		HPG IMPCO
AFTERCooler WATER INLET (°F):	130			WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210			
ASPIRATION:	TA	SITE CONDITIONS:		
COOLING SYSTEM:	JW+OC, AC	FUEL:		Field Gas
CONTROL SYSTEM:	ADEM3	FUEL PRESSURE RANGE(psig):		35.0-40.0
EXHAUST MANIFOLD:	ASWC	FUEL METHANE NUMBER:		62.2
COMBUSTION:	LOW EMISSION	FUEL LHV (Btu/scf):		1027
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	ALITUDE(ft):		5278
SET POINT TIMING:	27	MAXIMUM INLET AIR TEMPERATURE(°F):		48
		STANDARD RATED POWER:		1340 bhp@1400rpm

RATING	NOTES	LOAD	100%	100%	75%	53%
ENGINE POWER (WITHOUT FAN) INLET AIR TEMPERATURE	(1)	bhp °F	1273 43	1256 48	942 48	670 48

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7686	7698	7928	8345
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8493	8506	8780	9221
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	ft3/min	2523	2514	1895	1379
AIR FLOW	(WET)	lb/hr	11943	11786	8881	6462
FUEL FLOW (60°F, 14.7 psia)	(3)(4)	scfm	159	157	121	91
INLET MANIFOLD PRESSURE	(3)(4)	in Hg(abs)	68.2	67.4	53.1	39.9
EXHAUST TEMPERATURE - ENGINE OUTLET	(5)	°F	907	906	906	909
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	ft3/min	7414	7317	5518	4031
EXHAUST GAS MASS FLOW	(WET)	lb/hr	12414	12251	9240	6731

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00
CO	(8)(9)	g/bhp-hr	2.21	2.22	2.32	2.45
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.42	2.42	2.52	2.65
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.65	0.69
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.46
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.23
CO2	(8)(9)	g/bhp-hr	505	506	514	536
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.7	7.5

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	41814	41504	34599	28997
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	5047	5003	4173	3454
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	6236	6190	5160	4325
HEAT REJ. TO AFTERCoolER (AC)	(12)(13)	Btu/min	8332	8332	5045	1942

COOLING SYSTEM SIZING CRITERIA						
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	53479			
TOTAL AFTERCoolER CIRCUIT (AC)	(13)(14)	Btu/min	8748			
A cooling system safety factor of 0% has been added to the cooling system sizing criteria.						

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Max. rating is the maximum capability for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 1 - intake man press -> 33 psi -> 67.19 in Hg
Pabs = 67.19 in Hg

by linear interpolation, est BHP => 1251.4 BHP

G3516

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - RBU 11-18F #3

CATERPILLAR®

ENGINE SPEED (rpm):	1329	RATING STRATEGY:		STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:		CONTINUOUS
AFTERCooler TYPE:	SCAC	FUEL SYSTEM:		HPG IMPCO
AFTERCooler WATER INLET (°F):	130			WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210			
ASPIRATION:	TA	SITE CONDITIONS:		
COOLING SYSTEM:	JW+OC, AC	FUEL:		Field Gas
CONTROL SYSTEM:	ADEM3	FUEL PRESSURE RANGE(psig):		35.0-40.0
EXHAUST MANIFOLD:	ASWC	FUEL METHANE NUMBER:		62.2
COMBUSTION:	LOW EMISSION	FUEL LHV (Btu/scf):		1027
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0	ALITUDE(ft):		5278
SET POINT TIMING:	27	MAXIMUM INLET AIR TEMPERATURE(°F):		50
		STANDARD RATED POWER:		1340 bhp@1400rpm

RATING	(WITHOUT FAN)	NOTES	LOAD	MAXIMUM RATING			SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
				100%	100%	75%	54%		
ENGINE POWER		(1)	bhp	1272	1249	937	670		
INLET AIR TEMPERATURE			°F	43	50	50	50		

ENGINE DATA									
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7686	7702	7933	8343			
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8493	8510	8766	9219			
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(3)(4)	ft3/min	2521	2511	1892	1383		
AIR FLOW	(WET)	(3)(4)	lb/hr	11932	11722	8834	6459		
FUEL FLOW (60°F, 14.7 psia)			scfm	159	156	121	91		
INLET MANIFOLD PRESSURE		(5)	in Hg(abs)	68.2	67.2	52.9	39.9		
EXHAUST TEMPERATURE - ENGINE OUTLET		(6)	°F	906	906	906	909		
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(7)(4)	ft3/min	7407	7277	5489	4030		
EXHAUST GAS MASS FLOW	(WET)	(7)(4)	lb/hr	12403	12185	9192	6729		

EMISSIONS DATA - ENGINE OUT									
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00			
CO	(8)(9)	g/bhp-hr	2.21	2.22	2.32	2.45			
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.42	2.43	2.52	2.65			
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.65	0.69			
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.46			
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.23			
CO2	(8)(9)	g/bhp-hr	505	506	514	536			
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.7	7.5			

HEAT REJECTION									
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	41789	41372	34522	28986			
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	5044	4984	4159	3453			
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	6232	6170	5149	4323			
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	8316	8316	4974	1940			

COOLING SYSTEM SIZING CRITERIA									
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	53447						
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	8732						

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS
 Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Max. rating is the maximum capability for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 2 - intake man press -> 33 psi -> 67.19 in Hg
 Pabs = 67.19 in Hg

by linear interpolation, est BHP => 1248.8 BHP

G3516

GAS COMPRESSION APPLICATION

GAS ENGINE SITE SPECIFIC TECHNICAL DATA XTO - RBU 11-18F #3



ENGINE SPEED (rpm):	1327	RATING STRATEGY:	STANDARD
COMPRESSION RATIO:	8:1	RATING LEVEL:	CONTINUOUS
AFTERCooler TYPE:	SCAC	FUEL SYSTEM:	HPG IMPCO
AFTERCooler WATER INLET (°F):	130		WITH AIR FUEL RATIO CONTROL
JACKET WATER OUTLET (°F):	210		
ASPIRATION:	TA		
COOLING SYSTEM:	JW+OC, AC		Field Gas
CONTROL SYSTEM:	ADEM3		35.0-40.0
EXHAUST MANIFOLD:	ASWC		62.2
COMBUSTION:	LOW EMISSION		1027
NOx EMISSION LEVEL (g/bhp-hr NOx):	2.0		5278
SET POINT TIMING:	27		46
		STANDARD RATED POWER:	1340 bhp@1400rpm

RATING	NOTES	LOAD	MAXIMUM RATING	SITE RATING AT MAXIMUM INLET AIR TEMPERATURE		
ENGINE POWER (WITHOUT FAN) INLET AIR TEMPERATURE	(1)	bhp °F	1270 43	100%	100%	75% 53%

ENGINE DATA						
FUEL CONSUMPTION (LHV)	(2)	Btu/bhp-hr	7685	7692	7918	8338
FUEL CONSUMPTION (HHV)	(2)	Btu/bhp-hr	8492	8500	8750	9214
AIR FLOW (@inlet air temp, 14.7 psia)	(WET)	(3)(4)	ft3/min	2516	2510	1891
AIR FLOW	(WET)	(3)(4)	lb/hr	11910	11811	1372
FUEL FLOW (60°F, 14.7 psia)			scfm	158	157	121
INLET MANIFOLD PRESSURE			in Hg(abs)	68.1	67.6	53.3
EXHAUST TEMPERATURE - ENGINE OUTLET			°F	906	906	905
EXHAUST GAS FLOW (@engine outlet temp, 14.5 psia)	(WET)	(7)(4)	ft3/min	7394	7332	5527
EXHAUST GAS MASS FLOW	(WET)	(7)(4)	lb/hr	12380	12277	4027
					9257	6724

EMISSIONS DATA - ENGINE OUT						
NOx (as NO2)	(8)(9)	g/bhp-hr	2.00	2.00	2.00	2.00
CO	(8)(9)	g/bhp-hr	2.21	2.21	2.31	2.44
THC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	2.42	2.42	2.52	2.64
NMHC (mol. wt. of 15.84)	(8)(9)	g/bhp-hr	0.63	0.63	0.65	0.69
NMNEHC (VOCs) (mol. wt. of 15.84)	(8)(9)(10)	g/bhp-hr	0.42	0.42	0.44	0.46
HCHO (Formaldehyde)	(8)(9)	g/bhp-hr	0.22	0.22	0.22	0.23
CO2	(8)(9)	g/bhp-hr	505	506	514	536
EXHAUST OXYGEN	(8)(11)	% DRY	7.8	7.8	7.7	7.5

HEAT REJECTION						
HEAT REJ. TO JACKET WATER (JW)	(12)	Btu/min	41739	41543	34593	28962
HEAT REJ. TO ATMOSPHERE	(12)	Btu/min	5036	5008	4176	3451
HEAT REJ. TO LUBE OIL (OC)	(12)	Btu/min	6225	6196	5159	4319
HEAT REJ. TO AFTERCOOLER (AC)	(12)(13)	Btu/min	8285	8285	5073	1936

COOLING SYSTEM SIZING CRITERIA			
TOTAL JACKET WATER CIRCUIT (JW+OC)	(13)	Btu/min	53382
TOTAL AFTERCOOLER CIRCUIT (AC)	(13)(14)	Btu/min	8700

A cooling system safety factor of 0% has been added to the cooling system sizing criteria.

CONDITIONS AND DEFINITIONS

Engine rating obtained and presented in accordance with ISO 3046/1, adjusted for fuel, site altitude and site inlet air temperature. 100% rating at maximum inlet air temperature is the maximum engine capability for the specified fuel at site altitude and maximum site inlet air temperature. Max. rating is the maximum capability for the specified fuel at site altitude and reduced inlet air temperature. Lowest load point is the lowest continuous duty operating load allowed. No overload permitted at rating shown.

For notes information consult page three.

Run 3 - intake man press -> 33 psi -> 67.19 in Hg

Pabs = 67.19 in Hg

by linear interpolation, est BHP => 1250.0 BHP

APPENDIX D

FTIR Engine Test Sheet

Company Name	XTO
Location / Unit I.D.	RBU 11-18 #3
Type of Test Completed:	FTIR 3-lhr NOx, CO, HC's I PFT
Field Technician (s)	Jeff
Client Rep and/or State Rep	Cole - XTO
Date:	3-18-14

	Test 1	Test 2	Test 3
Time of Readings	2:41 pm	3:32 pm	
Atm Pressure (in Hg)	24.85	24.82	24.93
Atm Temp (°F)	49°	56°	46°
Engine RPM	1330	1329	1327
*Manifold Pres. Vac(") or Boost(psi)	33	33	33
Manifold Temp (°F)	127°	129°	131°
Psuction (psi) Stage 1	32	32	32
Tsuction (°F) Stage 1	53°	51°	49°
Pdischarge (psi) Stage 1	143	142	143
Psuction (psi) Stage 2	143	142	143
Tsuction (°F) Stage 2	106°	100°	100°
Pdischarge (psi) Stage 2	461	460	459
Psuction (psi) Stage 3	461	460	459
Tsuction (°F) Stage 3	97°	98°	99°
Pdischarge (psi) Stage 3	1064	1062	1063
Psuction (psi) Stage 4			
Tsuction (°F) Stage 4			
Pdischarge (psi) Stage 4			
Gas Throughput (mmcf/d)			
Pre CO (ppm)			
Pre Cat Temp (°F)	773	774	776
Post Cat Temp (°F)	745°	746	746°
Cat Differential Pres. (° of H2O)	14.2	14.2	14.2
Impinger 1 (grams)	/	/	/
Impinger 2 (grams)	/	/	/
Impinger 3 (grams)	/	/	/
Impinger 4 (grams)	/	/	/
Dry Gas Meter (cubic ft)	/	/	/
DGM Inlet Temp (deg F)	/	/	/
DGM Outlet Temp (deg F)	/	/	/
O2 %	8.4	8.5	8.5
CO2 %	7.5	7.5	7.5
LOAD %	93	93	93
Delta H			
Ignition Timing (°F)	26.7	26.6	26.5
AFR Setting mV (Left Bank)			
AFR Setting mV (Right Bank)			
Upstream Port Distance (pd)	20"		
Downstream Port Distance (pd)	36"		
Exhaust Diameter (inches)	12"		
Propane	479.9		
NO	496.9		
CO	499.5		
NO2	146.5		
Ethylene	100		
Methane	512		
Acetaldehyde	36		
Engine Make	C9T		
Engine Model	3516		
Engine S/N	WPW60173		
		Cylinder Serial #↓	

* Some units show boost in inches of Hg. In this situation please indicate if it is positive (+) or negative(-). Eg: (+12") or (-5")

Rev 5

5/25/2011

TEST RUN #1 XTO RBU #3

TEST RUN #3 XTO RBU #3

TEST RUN						EPA REFERENCE				Cp = 0.84
Stack Diameter		12'	Inches	Kp =	METHOD 2					
Traverse Points		16		Port	Point	85.49 ft/sec	dP	Ts	Stat P	
Ports		2				Insertion Depth(inches)	(in h2O)	(deg R)	(in H2O)	Static
Average O2		8.4	(% dry)	A	1	.384	3.9	746'		1.71
Average CO2		7.5	(% dry)	A	2	1.26	3.7			
Average N2 + CO			(% dry)	A	3	2.328	3.4			
Dry Molecular Weight			lb/lbmol	A	4	3.876	3.0			
Wet Molecular Weight			lb/lbmol	A	5	8.124	3.1			
Barometric Pressure				A	6	9.672	3.3			
Gas Meter Constant				A	7	10.74	3.6			
Gas Volume Constant				A	8	11.62	3.8			
Dry Gas Volume				A	9					
Water Vapor Volume				deg R/in Hg	A	10				
Moisture Content				dscf	A	11				
Dry Gas Met. Vol				scf	A	12				
Gas Met. Inlet Temp.				%	A	13				
Gas Met. Outlet Temp.				A	14					
Mass Liquid H2O				dscf	A	15				
Mass Of Silica Gel				deg F	A	16				
Average Analyzer NOx Level				deg F	B	1	.384	3.88	746'	1.71
Average Corrected NOx Level				grams	B	2	1.26	3.68		
Calculated NOx Mass Output				grams	B	3	2.328	3.41		
Calculated NOx Output				B	4	3.876	3.06			
Average Analyzer CO Level				ppm	B	5	8.124	3.08		
Average Corrected CO Level				ppm	B	6	9.672	3.39		
Calculated CO Mass Output				lbs/hr	B	7	10.74	3.55		
Calculated CO Output				gr/BHP-hr	B	8	11.62	3.64		
Average Analyzer NMHC Level				B	9					
Average Corrected NMHC Level (wet)				ppm	B	10				
Average Corrected NMHC Level (dry)				ppm	B	11				
Calculated NMHC Mass Output				lbs/hr	B	12				
Calculated NMHC Output				gr/BHP-hr	B	13				
IMPINGER DATA	1	2	3	B	14					
START				ppm	B	15				
FINISH				ppm	B	16				